Permabond® Adhesive Guide

-Our science... your success

Permabond®
Engineering Adhesives

www.permabond.com

Permabond Adhesives

ISO 9001:2008 Certified
Our Science ... Your Success

Adhesives for • Design • Manufacturing • Assembly • Maintenence • Repair & Overhaul

Permabond's history of developing and manufacturing engineering adhesives spans **four decades** and three continents. Today, Permabond Engineering Adhesives Ltd (Europe & Asia) and Permabond LLC (Americas) provide technological solutions to engineers all over the world, with offices and facilities in America, Asia and Europe, backed by a high-tech **ISO 9001:2008** certified production plant in Europe.

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This brochure contains information on our most popular products, if you don't see exactly what you need, or would like assistance in selecting the best product for your application, please contact us:

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Permabond® Engineering Adhesives

Adhesive Selection

Adhesive Selection

Selecting the most appropriate adhesive for an engineering application requires consideration of a number of factors:

- Surfaces
- Joint Design
- Service Conditions
- Production Processes
- Adhesive Recommendations

Surfaces:

- Can the substrate(s) be bonded?
- Which adhesive works best on the substrate?
- What are the surface preparation requirements?
- Reactivity of the substrate affects adhesive cure-speed.

Table below shows how **anaerobic adhesive** cure is affected by surface reactivity:

Super Active (Very fast cure)	Active (Fast cure)	Inactive (Slow cure)	Passive (Activator required)
Brass Copper Magnesium	Steel Nickel Iron Aluminium Zinc	Anodized aluminium Cadmium finishes Chrome finishes Passivated metals Stainless steel Titanium	Ceramics Glass Plastics Painted finishes Lacquered finishes

Gap fill and adhesive viscosity:

Viscosity of adhesive and gap fill capability are closely related - the higher the adhesive viscosity, the larger the gap filling capability.
To help "get a feel" for viscosity measurements, the list below shows everyday substances and their approximate viscosity:

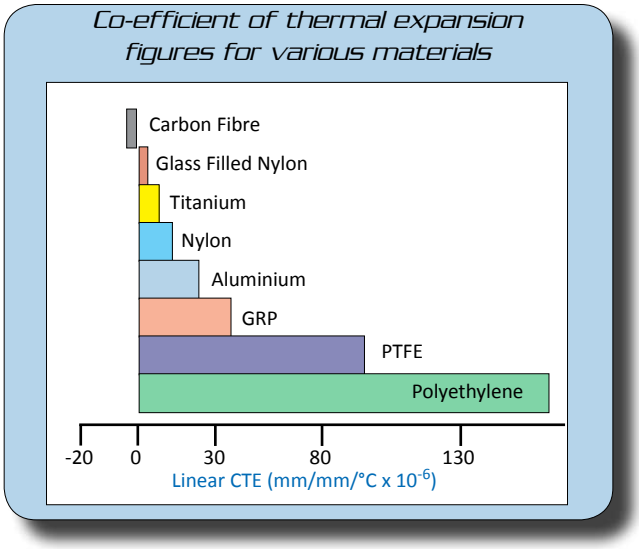
Substance	Viscosity (mPa.s)	Substance	Viscosity (mPa.s)
Water	1	Maple syrup	5,000
Milk	3	Honey	10,000
SAE 10 Motor oil	85-140	Choc. syrup	25,000
SAE 20 Motor oil	140-420	Ketchup	50,000
SAE 30 Motor oil	420-650	Mustard	70,000
SAE 40 Motor oil	650-900	Sour cream	100,000
Castor oil	1,000	Peanut butter	250,000

Service conditions:

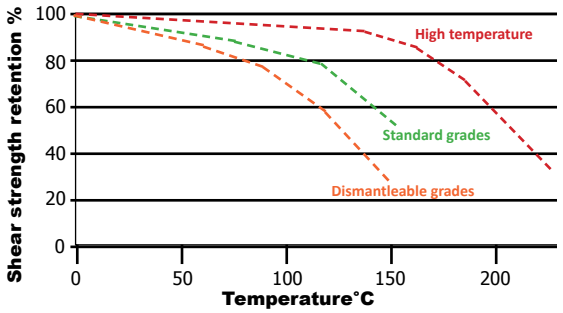
Chemical exposure and environmental conditions affect adhesives, therefore it is important to consider not only the type of chemical the adhesive will be exposed to, but the concentration and the temperature of that chemical, the loading of the joint and whether the joint design leaves adhesive vulnerable to attack.

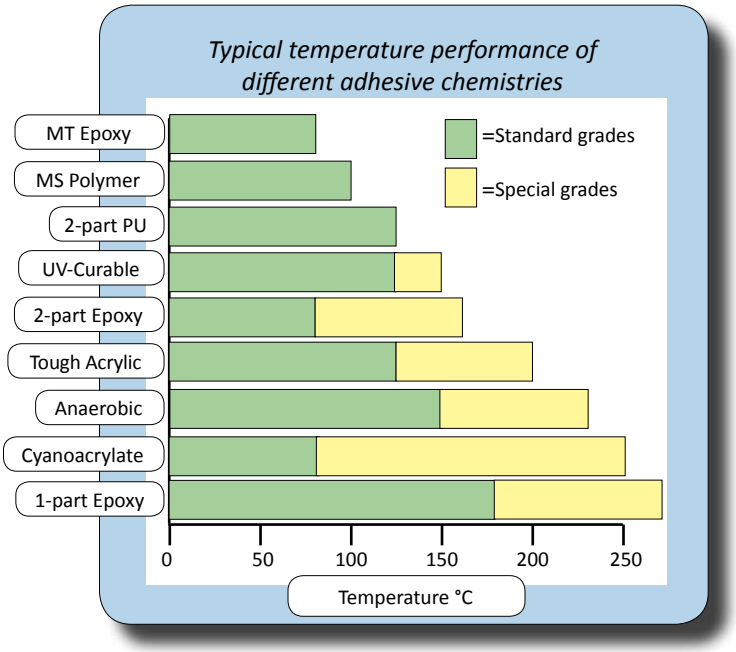
The temperature range the joint will be exposed to is an important factor in deciding which adhesive to use. Adhesive strength reduces as temperature increases, as demonstrated in the graph to the right. Provided adhesives are kept within their recommended temperature range, full strength should be regained upon returning to room temperature.

Bonding dissimilar materials together requires special consideration, particularly in an environment subject to temperature change. This is because differential thermal expansion and contraction between materials can induce stress into the substrates and into the joint. For this reason slightly flexible, toughened adhesives can be better than rigid methods of fixture - such as mechanical fastenings.



Hot strength of Permabond anaerobic adhesives:



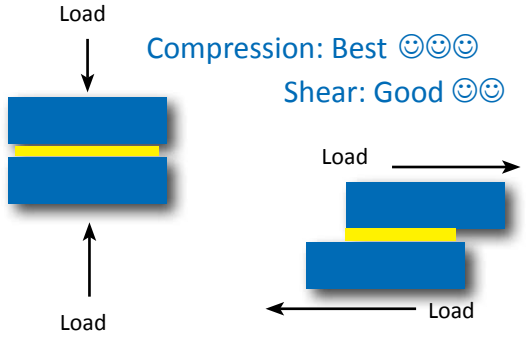


Joint Design

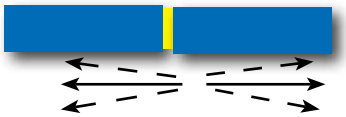
There are three basic joint types; co-axial, lap and butt joints. Anaerobic adhesives are usually most suitable for co-axial type joints (where one part slots into another) or for threaded parts. Whether or not the joint needs to be dismantled will determine the strength of adhesive to use.

It is vital to consider joint configuration in the early stages of your product design to achieve maximum performance. Joints that have originally been designed to be welded may need to be redesigned to obtain optimum performance with adhesives. The engineer also needs to consider the loading of these joints and where the forces occur. The diagrams on this page explain which joints are good, which to avoid and some suggested alternative joint designs.

These are examples of good adhesive joint design.

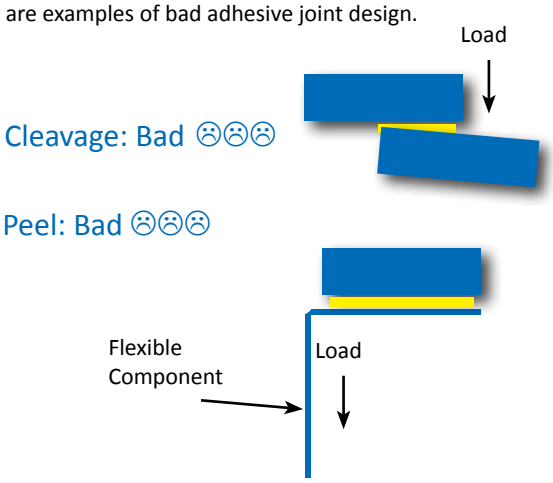


Straight Butt-Joint: Bad ☹☹☹



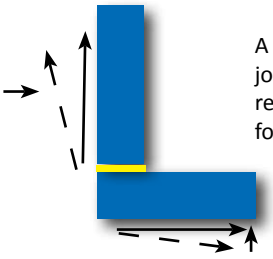
Problems occur because this type of joint is not very stable; a slightly off-centre force will cause a crack to propagate through the joint.

These are examples of bad adhesive joint design.



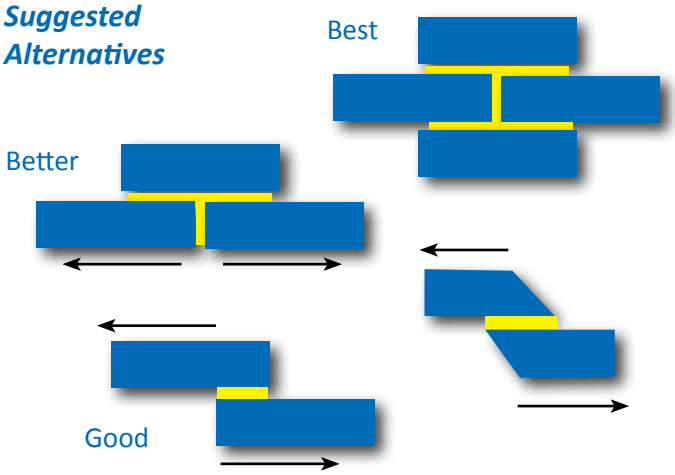
Handy Tip: If joint design cannot be modified, opt to use a toughened adhesive with high peel-strength.

Corner Butt-Joint: Bad ☹☹☹

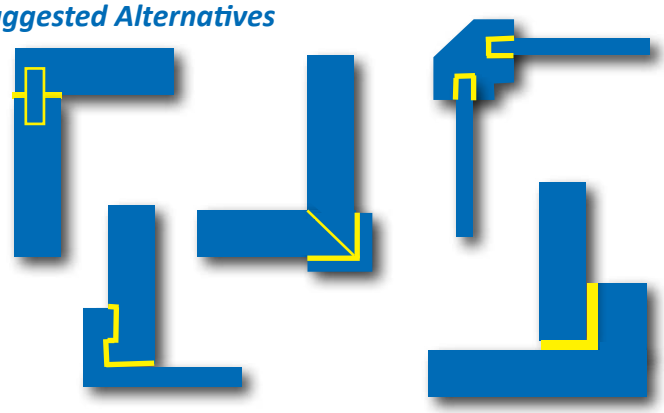


A similar problem can occur with a corner joint, if an indirect force is applied, it can result in the introduction of a cleavage force into the joint.

Suggested Alternatives

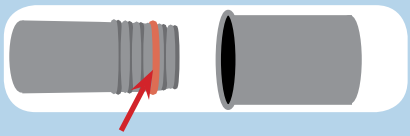


Suggested Alternatives



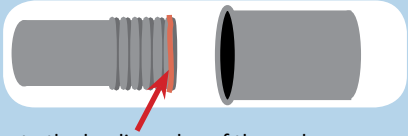
Correct assembly technique for pipe joints

■ Taper to parallel pipe joints



Apply adhesive several threads back from the leading edge of the male component to ensure maximum contact.

■ Parallel to parallel pipe joints



Apply adhesive to the leading edge of the male component. EXCESS ADHESIVE SHOULD BE SEEN IN BOTH CASES AFTER TIGHTENING

Coverage

Handy Tip: 1 litre of adhesive covers 1 square metre at a thickness of 1 mm *i.e. if only 0.5 mm thick, 1 litre will cover 2 square metres.*

Usage Estimator

The number of free flow drops per container (cyanoacrylate):

Container Size	Number of Drops
3g	45
20g	300
28g (1 oz)	420
30g	450
300g	4500
454g (1lb)	6810
500g	7500
2kg	30,000

Container Size	Number of Drops
10ml	150
50ml	750
75ml	1125
250ml	3750
300ml	4500
500ml	7500
750ml	11,250
1 litre	15,000

Flat bond (any adhesive):
Length (cm) x Width (cm) x Gap (cm) = Volume (ml)
To get an answer in ml, convert all your dimensions to cm first.

Potting a cylinder:
3.14 x radius (cm)^2 x length of cylinder (cm) = ml.
Radius is half the diameter.

50ml of adhesive will go how far?

Bead Diameter	Length of Bead	Glue line thickness (over 25mm width)
1.5mm	25m	0.075mm
3mm	6m	0.3mm
6mm	1.5m	1.2 mm

Usage Estimator - Threaded Fasteners

Metric size	Imperial size	Volume of adhesive per fastener	How many pipe-joints per bottle?	
			50ml	200ml
3mm	1/8”	0.07ml	700	2,800
6mm	1/4”	0.1ml	500	2,000
9mm	3/8”	0.12ml	400	1,600
12mm	1/2”	0.14ml	340	1,360
19mm	3/4”	0.193ml	260	1,040
25mm	1”	0.242ml	200	800

Production Line Considerations

Substrate preparation on a high-speed production line

It is helpful to receive substrate components in a consistent condition with little variation in surface finish. We would recommend checking this regularly as sometimes component suppliers switch materials, cutting oils or release agents which could necessitate changes in surface preparation technique. For large batch production, components can be degreased via large-scale jet washes on a conveyor system. It is important that such systems are not overloaded and that parts can drain off to give a consistently clean/dry surface afterwards.

Grit blasters offer a quick and easy way to abrade metal surfaces to remove oxide layers. It is important to change grit regularly to keep it sharp and free from contamination.

Surface activators, such as the Permabond CSA (for cyanoacrylates) and A905 (for anaerobics), are available in bulk for batch dipping of components. This helps to ensure a clean, reactive surface for the corresponding adhesive to bond to.

Dispensing methods

For a rapid production line, high-speed dispensing systems can easily be introduced. These can range from semi-automatic (e.g. a system which delivers a metered dose to the component after a person triggers the dispensing valve via foot pedal), to fully automatic where minimal human intervention is required. Permabond offer adhesive products in bulk packaging to fit most dispensing equipment around the world.
Two-part adhesives require more consideration to ensure the metered dose of resin and hardener is correct and that mixing is adequate. Upon installation the equipment must be properly calibrated to ensure the correct mix ratio of adhesive is being dispensed.

Automation

For high-speed production lines conveyors, robotics and X-Y machines can greatly aid increased production rates. Adhesives can easily be incorporated into highly automated systems with minimal cost.

Clamping / jigging & cure speed

It is important bonded parts are not disturbed during the curing process, at least until they have reached handling strength. Otherwise components could end up wrongly aligned or could result in a lower bond strength. To keep clamping time to a minimum, choose one of Permabond’s rapid curing adhesives to speed up production rates.

- UV-curables - cure in 1-2 seconds on exposure to high-intensity UV-light
- Cyanoacrylates - cure to handling strength in 1 - 30 seconds
- Structural acrylics - quick curing grades reach handling strength in 1-4 minutes
- Two-part polyurethanes - rapid gel time between 2 and 20 minutes
- Anaerobics - range from two minutes up 1 hour depending on substrates
- Two-part epoxies - can range from 5 minutes to several hours depending on grade
- Single-part heat-cure epoxies - dependent on cure temperature / heating method
- MS-polymers take days to cure - even weeks depending on glue line thickness

Curing Equipment

Permabond UV adhesives have been developed to cure quickly and easily, even with low powered lamps. This makes it a lot easier for trialling adhesives or for small users to use UV-curables without having to invest in high-tech equipment. We recommend the use of professional UV-lamps where possible, particularly for regular production items and where consistent results are essential.
Single-part epoxies require heat input either by oven, infra-red lamp, hot air gun or induction heating. Two-part epoxy cure can also be accelerated by heating bonded parts.
Please contact Permabond for further information on equipment suppliers.

Surface Preparation

Surface	Preparation Method	Bonding
ABS	ABS can be bonded “as received” so no surface preparation required.	Most PB grades suitable, if using AA use A905. ES may not be suitable as plastic may melt. UV will require a clear substrate.
Acetal	Acetal can be very difficult to bond; abrading the surface can help.	AA- Use A905. Best option is a CA with POP Primer.
Acrylic	Acrylic can be bonded “as received” so no surface preparation required.	Most PB grades suitable, if using AA use A905. ES may not be suitable as plastic may melt. UV will require a clear substrate.
Aluminium	Several options - The most effective is to immerse the aluminium in phosphoric acid etch solution for 30 minutes, rinse, dry and then bond immediately. However, health and safety restrictions imposed may prevent the preparation and storage of such chemicals. Alternatively: Degrease with Isopropanol, Acetone or Permabond Cleaner A. Do not use white spirits, meths etc. as these can leave a residue. Abrade with carborundum grit paper or if you have access to a grit or sand blaster, abrade the aluminium with fresh grit or sand. Degrease the aluminium a second time and then bond immediately. It is important to degrease before and after abrasion to avoid ingraining dirt and contaminants into the metal and to remove any loose particles and dirt afterwards. Aluminium forms a weak invisible oxide layer very quickly so bond ASAP. Low strength bonds on aluminium can usually be attributed to this oxide layer.	AA cure on aluminium can be slow so A905 may be required. If bonding to a different metal consider F201 or F202 flexible grade to cope with differential expansion. ET, ES and TA particularly good for bonding aluminium. TA4300 and TA4310 are particular favourites on this substrate, also ES550 performs very well on aluminium. UV can be used but other substrate needs to be clear (unless using a dual cure product such as UV7141). PT and MS products also work well on aluminium.
Brass	Degrease with isopropanol, acetone or Permabond Cleaner A. Do not use white spirits, meths etc. as these can leave a residue. Abrade with carborundum grit paper or if you have access to a grit or sand blaster, abrade the brass with fresh grit or sand. Degrease the brass a second time and then bond immediately. It is important to degrease before and after abrasion to avoid ingraining dirt and contaminants into the metal and to remove any loose particles and dirt afterwards. Brass can be etched with 25% ammonium persulphate solution to give a very good surface for bonding.	AA, ET, ES, TA, PT, all very good on brass. CA and MS are OK. UV can be used but other substrate needs to be clear (unless using a dual cure product such as UV7141).
Butyl Rubber	Wipe clean with isopropanol or Permabond Cleaner A to remove any processing lubricants and slip additives. Permabond cyanoacrylates all work brilliantly on butyl rubber. The bonded joint is generally stronger than the parent material.	Only cyanoacrylates can be considered on this surface.
Carbon Fibre	Lightly abrade surface with Scotchbrite or carborundum paper. Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding.	CA, ET, MT, MS, ES, PT all work well on this substrate. Specialist grades available.
Cast Iron	Remove large particles of rust and debris with a wire brush or wire wool. Degrease with isopropanol, Acetone or Permabond Cleaner A. Do not use white spirits, meths etc. as these can leave a residue. Abrade with carborundum grit paper or if you have access to a grit or sand blaster, abrade the cast iron with fresh grit or sand. Degrease the cast iron a second time and then bond immediately. It is important to degrease before and after abrasion to avoid ingraining dirt and contaminants into the metal and to remove any loose particles and dirt afterwards. Rust spots are the visible sign of surface oxidation on iron. It is important to bond ASAP after preparing the surface to prevent re-oxidation.	AA, ET, ES, all work well. If using CA then use 910 methyl grade for better durability and higher strength bond.
Ceramic	Glaze should be removed by abrasion or gritblasting, loose particles should then be removed. Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding.	ET, ES or TA would be best choice. AA would need A905 activator. CA durability could be poor.
Chrome	Degrease with isopropanol, Acetone or Permabond Cleaner A. Do not use white spirits, meths etc. as these can leave a residue. Bonding chrome can be difficult because of its mirror-finish ultra-smooth surface.	AA HM163 or HM135 are recommended for use on this surface.
Composite	Lightly abrade surface with Scotchbrite or carborundum paper. Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding.	CA, ET, MT, MS, ES, PT all work well on this substrate. Specialist grades available.
Concrete	Remove large particles of dust and debris with a stiff brush. Ensure surfaces are as dry and clean as possible and free of oil.	High viscosity ET or an MS would be most suitable for this surface.

Key:

AA=Anaerobic CA=Cyanoacrylate ET=2-Part Epoxy ES=Heat-Cure Epoxy MS=MS-Polymer
TA=Structural Acrylic PT=Two-Part Polyurethane UV-Curable

Surface Preparation

Surface	Preparation Method	Bonding
Copper	Degrease with isopropanol, acetone or Permabond Cleaner A. Do not use white spirits, meths etc. as these can leave a residue. Abrade with carborundum grit paper or if you have access to a grit or sand blaster, abrade the copper with fresh grit or sand. Degrease the copper a second time and then bond immediately. It is important to degrease before and after abrasion to avoid ingraining dirt and contaminants into the metal and to remove any loose particles and dirt afterwards. Copper can be etched with 25% ammonium persulphate solution to give a very good surface for bonding.	AA, ET, ES, TA, PT, all very good on copper. CA and MS are OK. UV can be used but other substrate needs to be clear (unless using a dual cure product such as UV7141).
Corian	Lightly abrade surface with Scotchbrite or carborundum paper. Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding.	ET is an excellent choice. Also TA, PT & MS are good. CA can be used if necessary. AA and ES are not suitable.
CRP	Lightly abrade surface with Scotchbrite or carborundum paper. Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding.	CA, ET, MT, MS, ES, PT all work well on this substrate. Specialist grades available.
Diamond	Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding.	UV recommended to give clear, non-yellowing bond. For diamond tipped tools, ES550 is normally used.
EPDM Rubber	Wipe clean with isopropanol or suitable solvent. Options for bonding EPDM are quite limited as EPDM can be a bit difficult to bond.	Permabond POP Primer and CA (normally the 105 would be recommended). Other adhesive technologies are generally unsuitable and will not bond EPDM rubber very well.
Ferrite	Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding.	TAs are first choice with rapid room temp cure, good impact and temperature resistance. CA - 737 can be used. ES products can also be recommended.
Formica	Lightly abrade surface with Scotchbrite or carborundum paper. Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding.	ET is an excellent choice. Also TA, PT & MS are good. CA can be used if necessary. AA and ES products are not suitable.
FRP	Lightly abrade surface with Scotchbrite or carborundum paper. Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding.	CA, ET, MT, MS, ES, PT all work well on this substrate. Specialist grades available.
Galvanized Zinc	Galvanised zinc can be quite a difficult surface to bond. It is difficult to remove the galvanised layer (as it is designed to protect the metal underneath). Bonding with a rubber toughened or slightly flexible adhesive can offer better results. Degrease with isopropanol, acetone or Permabond Cleaner A. Do not use white spirits, meths etc. as these can leave a residue.	Flexible grades perform better. 737, TA435, MS, MT, PT products are all recommended.
Glass	Degrease with Permabond Cleaner A or isopropanol. Glass can have a very thin layer of processing lubricant so it is important to degrease.	UV first choice for clarity and strength. MS359CLEAR can be used. TA will bond glass but the joint will be visible, ET should be used with 2K Primer first. CA durability is poor.
GRP	Lightly abrade surface with Scotchbrite or carborundum paper. Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding.	CA, ET, MT, MS, ES, PT products all work well on this substrate. Specialist grades available.
Gyprock	Remove large particles of dust and debris with a stiff brush. Ensure surfaces are as dry and clean as possible and free of oil.	MS first choice, particularly for large panels. ET or pre-mix TA could also be used.
HDPE	These polyolefin materials can prove challenging to bond due to their low surface energy. Unfortunately these substrates are very common due to their low cost and availability and frequently require bonding. Pretreat – corona, plasma or flame treat prior to bonding. Surface reactivity will decrease over time so bond ASAP after treating.	Permabond POP + CA (e.g. 105 or 2050) gives best results. Other adhesive technologies require significant pre-treatment. POP does not work with technology other than CA.
Laminate	Lightly abrade surface with Scotchbrite or carborundum paper. Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding.	ET is an excellent choice. Also TA, PT & MS are good. CA can be used if necessary. AA and ES are not suitable.
LCP	Best results can be achieved bonding LCP with UV adhesive - this gives a very high strength, durable and aesthetically pleasing bond. Alternatively any of the cyanoacrylate range can be used.	Use UV for best results. CA will also bond LCP well.
LDPE	These polyolefin materials can prove challenging to bond due to their low surface energy. Unfortunately these substrates are very common due to their low cost and availability and frequently require bonding. Pretreat – corona, plasma or flame treat prior to bonding. Surface reactivity will decrease over time so bond ASAP after treating.	Permabond POP + CA (e.g. 105 or 2050) gives best results. Other adhesive technologies require significant pre-treatment. POP does not work with technology other than CA.
Magnet	Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding.	TA products are first choice with rapid room temp cure, good impact and temperature resistance. CA - 737 can be used. ES products can also be recommended although magnetism can be weakened during the heat cure process.

Key:

AA=Anaerobic CA=Cyanoacrylate ET=2-Part Epoxy ES=Heat-Cure Epoxy MS=MS-Polymer
TA=Structural Acrylic PT=Two-Part Polyurethane UV-Curable

Surface Preparation

Surface	Preparation Method	Bonding
Marble	Remove large particles of dust and debris with a stiff brush. Ensure surfaces are as dry and clean as possible and free of oil.	ET would be first choice, PT or MS could also be used. Beware no-Mix TAs - initiator staining on porous marble (pre-mix TAs are OK).
MDF	Lightly abrade surface with Scotchbrite or Carborundum paper. Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding.	ET is an excellent choice. Also TA, PT & MS also work well. CA can be used (and CSA activator if necessary). AA and ES are not suitable.
Mild Steel	Degrease with isopropanol, Acetone or Permabond Cleaner A. Do not use white spirits, meths etc. as these can leave a residue. Abrade with carborundum grit paper or if you have access to a grit or sand blaster, abrade the mild steel with fresh grit or sand. Degrease the mild steel a second time and then bond immediately. It is important to degrease before and after abrasion to avoid ingraining dirt and contaminants into the metal and to remove any loose particles and dirt afterwards. Rust spots are the visible sign of surface oxidation on mild steel. It is important to bond ASAP after preparing the surface to prevent re-oxidation.	AA, CA, ET, ES, MS, MT, PT, TA can be used. UV is also suitable providing the second substrate is clear or it is a dual cure grade.
Natural Rubber	Wipe clean with isopropanol or suitable solvent. Options for bonding natural rubber are quite limited as it can be a bit difficult to bond.	Permabond 105 cyanoacrylate is recommended. Other adhesive technologies are generally unsuitable and will not bond natural rubber very well.
Nitrile Rubber	Can be bonded “as received” or if you wish, wipe clean with isopropanol or a suitable solvent. Permabond cyanoacrylates all work brilliantly on nitrile rubber and will bond to such a high strength that the substrate will break before the bond does on destructive tests.	Any Permabond CA.
Nylon	Dry out at 60°C for several hours or overnight. Unfilled Nylon doesn’t usually bond well, glass filled is much better. Abrade surface to allow extra mechanical bonding. Degrease with isopropanol	AA- Activate with A905. CA - long term durability is poor. TA, ET, PT or MS can all be considered.
Passivated Zinc	Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding. Other surface preparation has very limited results.	AA particularly good. ET, ES and TA can also be considered.
PBT	Bond as received. This material can be difficult to bond and often requires a high temperature resistant adhesive.	ES5741 has been developed especially for bonding PBT.
PEEK	Bond as received. Surface preparation has little effect, this can be quite difficult to bond.	All adhesives equally poor on this surface.
PET	Recommended options are to surface treat these materials either by corona, plasma or flame treatment. The suitability will be dependent on the size and shape of the parts and the production line requirements. Once surface treated these surfaces can be bonded more easily with cyanoacrylate or UV-curable adhesive.	If suface preparation has been successful then look to CA or UV for bonding.
Phenolic	Phenolic can be bonded “as received” (so no surface preparation is required). Ensure surfaces are clean and dry.	CA, TA, ET, PT can be considered. ES will also bond this material if a customer is able to heat cure.
Plaster	Remove large particles of dust and debris with a stiff brush. Ensure surfaces are as dry and clean as possible and free of oil.	MS first choice, particularly for large panels. ET or pre-mix TA could also be used.
Polycarbonate	Polycarbonate can be bonded “as received” (so no surface preparation is required). Beware stress cracking.	CA - particularly the non-bloom grades. ET or TA can also be used (stress cracking with TA could be an issue). UV630 or UV640 are the best choice if the polycarbonate is transparent.
Polyethylene	These polyolefin materials can prove challenging to bond due to their low surface energy. Unfortunately these substrates are very common due to their low cost and availability and frequently require bonding. Pretreat – corona, plasma or flame treat prior to bonding. Surface reactivity will decrease over time so bond ASAP after treating.	Permabond POP + CA (e.g. 105 or 2050) gives best results. Other adhesive technologies require significant pre-treatment. POP does not work with technology other than CA.
Polypropylene	These polyolefin materials can prove challenging to bond due to their low surface energy. Unfortunately these substrates are very common due to their low cost and availability and frequently require bonding. Pretreat – corona, plasma or flame treat prior to bonding. Surface reactivity will decrease over time so bond ASAP after treating.	Permabond POP + CA (e.g. 105 or 2050) gives best results. Other adhesive technologies require significant pre-treatment. POP does not work with technology other than CA.
Polystyrene	Bond “as received” (so no surface preparation is required). Ensure surfaces are clean and dry. Beware stress cracking.	ET, TA, PT can be considered. CA can attack this substrate.
Polyurethane	Elastomeric PU can be bonded as received. Rigid PU: abrade and degrease. Some PUs resist abrasion.	Elastomeric PU bond with CA. Rigid PU - PT, ET or TA.
PTFE	Wipe clean with isopropanol or Permabond Cleaner A. Options for bonding PTFE are fairly limited. The easiest method is to prime with Permabond POP primer and then bond with Permabond 105. Alternatively, you can acid etch with “Tetra Etch” and then bond with epoxy, structural acrylic, cyanoacrylate, UV or anaerobic adhesive. PTFE can also be purchased pre-etched.	POP + CA 105. Other adhesive technologies require significant pre-treatment. POP does not work with technology other than CA.
PVC	Bond “as received” (so no surface preparation is required). Abrasion can help improve mechanical bond strength.	UPVC can be bonded with CA, ET, TA, UV. Flexible PVC restricted to CA, possibly a medical grade UV.

Key:

AA=Anaerobic CA=Cyanoacrylate ET=2-Part Epoxy ES=Heat-Cure Epoxy MS=MS-Polymer
TA=Structural Acrylic PT=Two-Part Polyurethane UV-Curable

Surface Preparation

Surface	Preparation Method	Bonding
Silicone	Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding.	Options for bonding silicone are very limited. The easiest method is to prime with Permabond POP primer and then bond with Permabond 105 or 731 for extra flexibility.
SMC	SMC is easy to bond – you just have to get rid of the release agents used and these are often internal. Light abrasion and solvent degrease is usually fine.	CA, ET, MT, MS, ES, PT all work well on this substrate. Specialist grades available.
Stainless Steel	Degrease with isopropanol, Acetone or Permabond Cleaner A. Do not use white spirits, meths etc. as these can leave a residue. Abrasion or shot blasting is necessary to remove the oxide film which has a low surface energy. Power tools can heat the metal causing it to re-oxidise instantly so keep metal cool. Abrasion through Permabond 2K Primer works well. Mirror-finish stainless steel can be particularly problematic.	AA: HM136 or HM163 can be considered. A regular AA could be used along with A905 to speed up cure. UV bonds well to stainless / glass. ET, TA, ES, CA, PT, MT, MS can also be used.
Steel	Degrease with isopropanol, acetone or Permabond Cleaner A. Do not use white spirits, meths etc. as these can leave a residue. Abrade with carborundum grit paper or if you have access to a grit or sand blaster, abrade the steel with fresh grit or sand. Degrease the steel a second time and then bond immediately. It is important to degrease before and after abrasion to avoid ingraining dirt and contaminants into the metal and to remove any loose particles and dirt afterwards. Rust spots are the visible sign of surface oxidation on steel. It is important to bond ASAP after preparing the surface to prevent re-oxidation. Different grades of steel will respond differently to abrasion – some are quite easy to abrade, while others are almost impossible.	AA, CA, ET, ES, MS, MT, PT, TA can be used. UV is also suitable providing the second substrate is clear or it is a dual cure grade.
Stone	Remove large particles of dust and debris with a stiff brush. Ensure surfaces are as dry and clean as possible and free of oil.	ET would be first choice, PT or MS could also be used. Beware TA - initiator staining on porous marble.
Teflon	Wipe clean with isopropanol or Permabond Cleaner A. Options for bonding Teflon are fairly limited. The easiest method is to prime with Permabond POP primer and then bond with Permabond 105. Alternatively, you can acid etch with "Tetra Etch" and then bond with epoxy, structural acrylic, cyanoacrylate, UV or anaerobic adhesive. Teflon (PTFE) can also be purchased pre-etched.	POP + CA 105. Other adhesive technologies require significant pre-treatment. POP does not work with technology other than CA. Epoxy, acrylic, anaerobic, UV and CA can all be used if surface is acid etched first.
Tufnol	Phenolic can be bonded "as received" (so no surface preparation is required). Ensure surfaces are clean and dry.	CA, TA, ET, PT can be considered. ES will also bond this material if heat cure if possible.
Tungsten Carbide	In many cases you don't need to do anything except ensure the surfaces are clean and dry so a solvent wipe works well – however remember that tungsten carbide is a sintered material and so can be semi porous. As a result solvent evaporation may take much longer than you expect. In some cases release agents are used on the moulds and these can be difficult to remove by washing alone. Shot blasting (using fresh grit) or etching with concentrated nitric acid can improve performance significantly.	For ultimate performance bond with toughened ES (e.g. ES550). Other technologies can be used but often strength performance isn't sufficient.
Viton	Can be bonded "as received" or if you wish, wipe clean with isopropanol or a suitable solvent. Permabond cyanoacrylates all work brilliantly on Viton rubber and will bond to such a high strength that the substrate will break before the bond does on destructive tests.	Any Permabond CA.
Wood	Lightly abrade surface with Scotchbrite or carborundum paper. Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding.	CA, ET, PT, MT, MS, TA all suitable
Zinc	Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding. Other surface preparation has very limited results.	AA particularly good if on threaded components. ET, ES and TA can also be considered.

Surface Cleaners Available from Permabond:	
Permabond 2K Primer	Silane surface pretreatment -2 part kit
Permabond Cleaner A	General purpose surface cleaner - available as an aerosol spray
IPA Wipes	Isopropanol wipe in convenient sachet

Key:

AA=Anaerobic CA=Cyanoacrylate ET=2-Part Epoxy ES=Heat-Cure Epoxy MS=MS-Polymer
TA=Structural Acrylic PT=Two-Part Polyurethane UV-Curable

Chemical Compatibility

Chemistry	Polar Solvents	Non-Polar Solvents
Anaerobic	Excellent	Excellent
Cyanoacrylate	Poor	Good
Toughened Acrylic	Good	Good
2-Part Epoxy	Very Good	Very Good
1-Part Epoxy	Very Good	Very Good
UV-Curable	Good	Good
2-Part PU	Good	Good
MS Polymer	Very Good	Good

Liquid Compatibility of Anaerobics ***NB High temperatures and high concentrated solutions may degrade adhesives.***	
Acetic Acid	Low concentration only
Acetone	OK
Alcohol	OK
Ammonia	Use high strength grade
Animal Fat	OK
Battery Acid	Not suitable
Bleach	OK
Bromine	Not suitable
Carbolic Acid	Low concentration only
Carbonic Acid	Low concentration only
Cement	OK
China Clay	OK
Chromic Acid	Use high strength grade
Copper Sulphate	OK
Creosote	OK
Cyanide Solution	Low concentration only
Detergents	OK
Dielectric Fluid	Depends on brand
Dye Stuffs	OK
Ethyl Acetate	OK
Ferric Chloride	Low concentration only
Fertilizer	Depends on brand
Formaldehyde	Use high strength grade
Glycerine	OK
Gypsum	OK
Hexane	OK
Hydrochloric Acid	Use high strength grade for low concentrations only
Ink	OK
Insecticide	Depends on brand
Isocyanate Resin	OK
Jet Fuel	OK
Kerosene	OK

Gas Compatibility of Anaerobics ***NB High temperatures and high concentrated solutions may degrade adhesives.***	
Air	OK
Carbon dioxide	OK
Carbon monoxide	OK
Chlorine	Not suitable
Freon	Use high strength grade
Helium	OK
Methane	OK
Natural gas	OK
Pure oxygen	MH052 only
Ozone	Not suitable
Propane	OK
Steam	Not suitable

Liquid Compatibility of Anaerobics ***NB High temperatures and high concentrated solutions may degrade adhesives.***	
Lactic Acid	OK
Nitric Acid	Not suitable
Oil (hydraulic)	OK
Oil (linseed)	OK
Oil (lubricating)	OK
Oil (mineral)	OK
Ozone (wet)	Not suitable
Paraffin	OK
Perfume	OK
Petrol	OK
Petroleum Jelly	OK
Photo Developer	OK
Phosphoric Acid	Use high strength grade for low concentrations only
Sewage	OK
Shellac	OK
Sodium Hydroxide	Use high strength grade for low concentrations only
Starch	OK
Sugar	OK
Sulphuric Acid	Use high strength grade for low concentrations only
Toluene	OK
Trichloroethane	OK
Turpentine	OK
Water (fresh/sea)	OK
Water (heavy)	OK
Xylene	OK

Anaerobics

The Permabond range of anaerobic adhesives is formulated to provide superior performance benefits in applications with self-supporting or closely-mating metallic components such as retaining bearings, threadlocking, flange sealing, gasketing and sealing pipe work.

How do Permabond anaerobic adhesives work?

Permabond anaerobic adhesive formulations are designed to cure when air is absent and metal surfaces (both ferrous and non-ferrous) are present. The liquid adhesive fills imperfections in the metal surfaces and gaps between the mated parts. The adhesive then rapidly cures to an inert acrylic adhesive/sealant creating a solid 100% mechanical surface-to-surface contact and physical lock.

Retaining Compounds:

Retaining adhesives are for the permanent bonding of co-axial joints. Typical applications include:

- Bearings into housings
- Bushes
- Keyways and splines
- Gears
- Rotors
- Pulleys
- Cylinder linings

Benefits of using retaining adhesive include rapid, quick and easy assembly of parts. Tolerances can be relaxed, reducing machining times and eliminating the need for interference fits. Adhesive strength is usually higher than alternative methods of fixture. Adhesives have a better fatigue life as they prevent metal fretting (which can be an issue with interference fits).

Handy Tip: Apply adhesive to leading edges of both components and assemble with a rotating action. Take extra care to prevent adhesive entering mechanisms and bearing races!

Threadlocking:

Permabond threadlocking anaerobic adhesives enable you to lock screws, nuts, bolts and studs to protect against loosening caused by vibration.

Benefits

- Prevents nuts rusting on to bolts
- Permabond offer a range of strengths - low strength for large parts which may require future disassembly, medium strength and high strength permanent threadlockers to prevent theft and vandalism.
- More cost-effective than using mechanical fastenings
- Lubricates for easier assembly
- Machining tolerances can be increased
- Seals against leaks
- Stops nuts and bolts working loose through vibration

Handy Tip: For blind holes, apply the adhesive directly into the bottom of the hole, not the fastener. If there is a void then apply the adhesive to the internal thread instead.

Pipe Sealing

Permabond pipesealing anaerobic adhesives are designed to replace traditional thread sealing materials such as hemp, PTFE tape, Boss White® and Boss Green® (for potable water).

Benefits

- No loose particles to clog valves
- Will not shred, creep or relax over time
- Easy to apply, allows accurate positioning of pipes and fittings
- Lubricates for easier assembly
- Seals to the burst pressure of the pipe when fully cured
- Suitable for water, gas, air and hydraulic systems
- Resistant to a wide variety of chemicals

Handy Tip: Pipe joints sealed with low-strength pipesealants can be dismantled using normal tools. Heating parts with a hot air gun or blow torch will help weaken adhesive and make parts easier to undo. Before re-using, clean pipe joints with a wire brush and chemically clean / degrease.

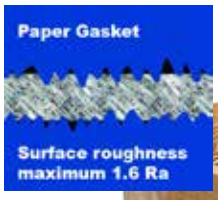
Gasketing

Permabond gasketing anaerobic adhesives are designed to replace traditional cork, wood, rubber, paper and silicone gaskets.

Benefits

- No relaxation or shrinkage so no need to retighten over time
- One adhesive will replace many pre-cut gasket shapes
- No need to handle fragile gaskets
- No disintegration so no leaks or blockages
- Vibration proof
- No long-term embrittlement
- Easy to dismantle with normal tools
- Less machining - surfaces need not be so smooth
- 100% metal to metal contact = better stress distribution.

Not only do liquid gasketing adhesives give 100% contact between metal parts, but they also allow the engineer to cut down the amount of surface-finish machining, therefore reducing costs and increasing production rate.



Anaerobic Product Chart

Purpose	Grade	Features	Colour	Viscosity (mPa.s)	Max. Gap Fill (mm)	Handling Time (mins) Steel	Shear Strength (MPa) steel	Torque Strength (Nm) M10 steel		Service Temperature (°C)
								Breakaway	Prevail	
Threadlocking	A011	Low strength	Red	500	0.12	15	5	4	3	-55 to +150
	A1042	Rapid cure	Blue	8,000 ST	0.12	5	12	16	7	-55 to +150
	A113	General purpose	Blue	500	0.12	15	12	16	7	-55 to +150
	A130	General purpose	Blue	8000	0.12	15	12	16	7	-55 to +150
	MM070	CoSHH friendly	Blue	4000	0.12	25	N/A	20	12	-55 to +150
	HM071	CoSHH friendly	Green	550	0.12	25	N/A	22	40	-55 to +150
	HM129	Permanent	Red	500	0.15	10	17	32	56	-55 to +150
	HH131	High temperature	Red	10,000 T	0.3	15	17	27	54	-55 to +230
Retaining	A025	High temperature	Orange	750	0.2	15	8	26	46	-55 to +200
	A118	Low viscosity	Green	500	0.12	15	21	33	58	-55 to +150
	A134	High viscosity	Green	70,000 T	0.5	15	21	33	58	-55 to +150
	A140	Gas approved	Green	37,500 T	0.5	15	21	33	58	-55 to +150
	F200	Toughened	Brown	200	0.1	15	21	33	58	-55 to +100
	F201	Toughened	Brown	9,000 ST	0.2	15	30	33	58	-55 to +100
	F202	Toughened	Brown	135,000 T	0.5	15	30	33	58	-55 to +100
	A1046	Rapid cure	Green	9,000 ST	0.25	5	25	33	58	-55 to +150
	HM135	Rapid cure	Green	500	0.2	5	30	38	65	-55 to +200
	HM162	High temperature	Green	800	0.2	5	30	32	62	-55 to +200
	HM163	For stainless steel	Green	4000	0.2	5	28	40	70	-55 to +150
	HM165	High temperature	Green	10,000 T	0.3	15	26	28	54	-55 to +230
	HH167	Metal repair	Silver	500,000 P	0.5	15	32	32	45	-55 to +150
Threadsealing	A1044	High strength	White	70,000 T	0.5	15	17	24	12	-55 to +150
	A129	Medium strength	Orange	65,000 T	0.5	15	12	12	5	-55 to +150
	A131	Low strength	White	40,000 T	0.5	45	6	10	4	-55 to +150
	MH052	Oxygen approved	Yellow	50,000 T	0.5	15	10	20	11	-55 to +150
	MH072	CoSHH friendly	Yellow	50,000 T	0.5	30	N/A	18	8	-55 to +150
	HM146	Gas approved	Green	3000	0.3	30	20	30	48	-55 to +150
	A1058	Very slow set	White	300,000 P	0.5	90	8	N/A	N/A	-55 to +150
Gasketing	A136	General purpose	Red	75,000 T	0.5	45	12	N/A	N/A	-55 to +150
	MH196	High temperature	Red	150,000 T	0.5	15	10	N/A	N/A	-55 to +200
	MH199	High temperature	Red	185,000 T	0.5	20	8	N/A	N/A	-55 to +200
	LH197	Flexible	Green	37,000 T	0.3	20	5	N/A	N/A	-55 to +150
Wicking Sealant	A126	Penetrative viscosity for post assembly application	Green	30	0.05	15	21	33	58	-55 to +150
	A1024		Yellow	20	0.05	20	N/A	12	N/A	-55 to +150
	A1062	Anaerobic / UV cure	Green	20	0.05	20	7	N/A	N/A	-55 to +150
	A905	Surface activator	Green	2						

T=Thixotropic P=Paste
ST=Slightly Thixotropic

Cyanoacrylates

Permabond cyanoacrylate adhesives bring a wide variety of performance benefits to the production environment. These benefits include joining dissimilar and hard-to-bond materials, quick curing with very strong adhesion and a wide range of viscosities. Permabond one-part cyanoacrylates are a versatile solution for even the most demanding manufacturing and assembly applications.

How do Permabond cyanoacrylate adhesives work?

Permabond cyanoacrylate adhesives are one-part adhesives that cure by reacting with minute traces of moisture on the surface of the material being bonded. Permabond cyanoacrylates cure in seconds at ambient temperatures and have been formulated to bond flexible or rigid surfaces made from a wide range of plastics, rubbers and metals.

Permabond cyanoacrylates are available in a range of viscosities and material adhesion capabilities. These adhesives have been developed to bond a variety of porous and non-porous surfaces and to bond rigid or flexible materials.

Typical applications include:

- Electronics wire tacking
- Bonding blue-tooth headsets
- Hose clips onto automotive tubes
- Bonding automotive interior trim
- Tacking parts during assembly process (temporarily)
- Joining silicone O-rings
- Disposable medical device bonding
- Bonding mobile phone casing, antennae and keypads
- Sealing batteries
- Glazing applications
- Sealing transformer laminates

Permabond low and medium viscosity cyanoacrylate formulations provide:

- Superior bonding to plastic, wood and rubber.
- Excellent bond strength when joining metal to plastic, or rubber to metal.
- Inherent corrosion resistance; protects part assembly from degradation.

Permabond high viscosity cyanoacrylate adhesives provide:

- Formulations for use in vertical applications or on porous surfaces.
- Gap filling ability up to 0.5mm.
- Fast cure time; speeds production rates.
- High-strength adhesion, up to 25MPa; shear strength exceeds that of many substrate materials.

Benefits

- One-part adhesive chemistry speeds preparation and application.
- Join dissimilar materials, such as rubber to metal, with no compromise in bond strength.
- Cures in seconds at room temperature; eliminates need for costly jigs or ovens; accelerates assembly rates.
- Gap fill up to 0.5mm.
- Solvent free; non flammable.
- Superior bond strength; often exceeds that of substrate material.
- Low odour non-blooming products available
- High-temperature resistance (up to 250°C).

Handy Tip: 'Less is more' - cyanoacrylates are very efficient so only small drops are required to obtain a high-strength bond.

Permabond® Engineering Adhesives

Cyanoacrylate Product Chart

Grade	Features	Viscosity (mPa.s)	Maximum Gap Fill (mm)	Shear Strength Steel (MPa)	Handling Times (seconds)			Service Temperature (°C)
					Rubber	Plastic	Metal	
101	Low viscosity, penetrating grade	1-3	0.05	19-23	2-5	5-10	3-5	-55 to +80
102	General purpose	70-90	0.15	19-23	5-10	7-10	10-15	-55 to +80
105	Difficult rubbers (e.g. EPDM)	30-50	0.10	18-22	5-10	5-10	10-15	-55 to +80
240	High viscosity, slow cure	1500-2500	0.43	21-25	15-20	15-20	15-20	-55 to +80
731	Highly flexible, toughened	100-200	0.15	24-30	15-20	30-45	30-50	-55 to +120
735	Highly flexible, toughened, black.	200-300	0.15	24-30	10-15	10-15	30-50	-55 to +120
737	Toughened - impact and peel resistant. Black	2000-4000	0.5	19-23	10-15	10-15	25-30	-55 to +120
791	Ultra fast cure, low viscosity	30-50	0.10	18-22	2-3	2-3	2-3	-55 to +80
792	Ultra fast cure, general purpose	70-90	0.15	18-22	2-3	2-3	2-3	-55 to +120
801	High temperature resistance	30-40	0.08	19-23	10-15	10-15	10-15	-55 to +130
802	High temperature resistance	90-110	0.15	19-23	10-15	10-15	10-15	-55 to +160
820	High temperature resistance	90-110	0.15	19-23	10-15	10-15	10-15	-55 to +200
910	Metal bonding	70-90	0.15	23-29	10-15	10-15	10-15	-55 to +90
920	High temperature resistance	70-90	0.15	19-23	10-15	10-15	15-20	-55 to +250*
940	Low odour, low bloom	5-10	0.05	16-20	2-5	10-15	10-15	-55 to +80
941	Low odour, low bloom	20-40	0.08	16-20	2-5	10-15	10-15	-55 to +80
943	Low odour, low bloom	90-110	0.15	16-20	2-5	5-10	10-15	-55 to +80
947	Low odour, low bloom	1000-1500	0.25	16-20	2-5	10-15	10-15	-55 to +80
2010	Very fast cure, thixotropic	2000-6000	0.5	19-23	10-15	10-15	10-15	-55 to +80
2011	Non-drip, non sag gel	Gel	0.5	20-24	5-10	5-10	5-10	-55 to +120
2012	Low-odour gel	80,000-120,000	0.5	16-20	10-40	10-40	10-40	-55 to +80
2013	High temperature gel	100,000-140,000	0.5	28-32	5-20	5-20	5-20	-55 to +160
2050	High viscosity, flexible	1000-2000	0.2	16-20	5-10	5-10	10-15	-55 to +80
4C10	Medical device bonding	30-50	0.1	13-15	5-15	5-10	5-15	-55 to +80
4C20	Medical device bonding	400-600	0.12	13-15	10-25	10-25	10-30	-55 to +80
4C30	Medical device bonding	1500	0.12	13-15	5-10	5-10	5-20	-55 to +80
4C40	Medical device bonding	2000	0.15	13-15	5-10	5-10	5-20	-55 to +80
POP	Polyolefin surface primer	0.6	For priming PE, PP, Silicone, PTFE before bonding with CA					
CPP621	Fingerprinting grade	1-3	N/A					
CSA	Surface activator	0.55	When using the cyanoacrylate adhesives to bond to acidic or porous surfaces, the use of Permabond CSA prior to bonding may be beneficial. Post assembly application of CSA-NF may also assist in the curing of adhesive fillets outside the bond area or in preventing the 'blooming' phenomenon sometimes associated with the use of this type of adhesive.					
CSA-NF	Non-blooming surface activator	1						

**Post cure required at high temperature*



Structural Acrylics

Permabond structural acrylic adhesives are suitable for bonding a wide variety of materials. The rapid, room-temperature cure coupled with high strength and durability, make these adhesives ideal for demanding applications where speed and ease of application of the adhesive is important.

Permabond structural acrylic adhesives are suitable for a variety of applications.

They are ideal for structural bonding of metals, composites, plastics, glass, wood and other materials. Permabond's structural acrylic adhesives offer excellent durability and resist tensile, peel, cleavage and impact forces. They resist the stresses of differential thermal expansion when bonding dissimilar materials.

Permabond structural acrylics are formulated with chemical resistance in mind, so are suitable for applications that involve exposure to oils, greases, moisture and weathering.

Typical applications include:

- Magnet bonding (particularly for electric motors)
- Metal & glass furniture manufacturing
- Street signs
- Rear view mirror attachment
- Structural bonding - e.g. aluminium stiffeners
- Shopfittings and facias

Permabond offers several types of structural acrylic adhesive;

No-Mix Adhesive & Initiator
Initiator is applied to one of the bonding surfaces and the adhesive to the other. Suited to bonding close fitting parts, this system provides a long open time and a short cure time.

Bead on Bead Part A & Part B
A bead of one part is applied directly over a bead of the other part. No hand mixing is required. When the two components are pressed together, enough mixing will take place to cure the adhesive.

2-Part Pre-Mix Resin & Hardener
Adhesive is supplied in convenient 1:1 cartridges for use with a dispensing gun. Adhesive is dispensed via a static mixing nozzle directly onto the substrate material.

Single Component - No mixing required
These adhesives are simple to apply and cure with or without an activator (activator can be used to reduce cure times to seconds and to cure through larger gaps).

Benefits

- Room temperature cure - eliminates ovens and other equipment.
- Rapid cure - increases daily output to reduce production costs.
- Non-flammable and solvent-free formulations available - provides a safe and comfortable work environment.
- Versatile - suitable for bonding a wide variety of substrates to increase design freedom.
- Technical support- application specialists available for assistance with joint design, adhesive selection and production process.

Permabond®
Engineering Adhesives

Structural Acrylic Product Chart

Grade	Features	Colour	Viscosity (mPa.s)	Max. Gap Fill (mm)	Handling Time (mins)	Working Strength (mins)	Shear Strength (MPa)	Service Temperature (°C)
TA430 & Initiator 41	Very high strength bonding of metals, plastics, ceramics and wood. Fast cure on close fitting parts.	Resin: Amber Initiator: Brown Mixed: Amber	28,000 - 32,000	0.5	Gap:~0mm (0 in) <2 mins 0.25mm (0.01 in) 10 mins 0.5mm (0.02 in) 20 mins	40-60	15-25	-55 to 120
TA435 & Initiator 41	Very high strength bonding of metals, ferrites and thermoplastics. High impact applications.	Resin: Amber Initiator: Brown Mixed: Amber	85,000 - 95,000	0.5	Gap:~0mm (0 in) <2 mins 0.25mm (0.01 in) 10 mins 0.5mm (0.02 in) 20 mins	30-60	15-25	-55 to 120
TA436 & Initiator 43	Very high strength bonding of metals, ferrites and hard plastics. High impact and high temperature applications.	Resin: Amber Initiator: Green Mixed: Green	16,000 - 18,000	0.5	1-3 minutes	30-60	15-25	-55 to 150
TA437	Single component. To bond ferrites and metals. For high temperature applications. Initiator 41 will accelerate cure	Resin: Orange *(Initiator: Brown)* *(Mixed: Dark orange)*	115,000 – 125,000	0.5	3-5 minutes 30-45 seconds with Initiator 41	30-60	14-20	-55 to 200
TA439 & Initiator 43	Methacrylic acid free structural adhesive for magnet bonding. Ideal for sealed electric motors. High temperature resistance.	Resin: Clear Initiator: Green Mixed: Green	800 - 1,200	0.12	10-20 seconds	20-40	10-12	-55 to 200
TA440	Bead on bead for rapid bonding of metal, glass, wood and rigid plastics.	Resin: Amber Initiator: Green Mixed: Green	8,000-12,000	0.5	<30 seconds	30-60	15-25	-55 to 120
TA459 & Initiator 43	High viscosity version of TA439	Resin: Clear Initiator: Green Mixed: Green	10,000-20,000	0.5	15-30 seconds	<3	12-18	-55 to 150
TA4246 & Initiator 46	No-mix resin and initiator for high strength bonding of metal, glass, composites and plastics.	Resin: Amber Initiator: Brown Mixed: Amber	28,000 - 32,000	0.5	2-4 minutes	15-30	33-35	-40 to 120
TA4300	2-part 1:1 rapid curing, gap filling, toughened. Ideal for structural bonding of aluminium.	Part A: Off-white Part B: Brown Mixed: Cream	Thixo Paste	2	5-10 minutes	15-30	20-22	-40 to 120
TA4302	2-part 1:1 very rapid cure, can be applied bead on bead, multipurpose.	Part A: Pink Part B: Green Mixed: Grey	4,000 - 5,000	0.5	3-5 minutes	15-30	22-25	-40 to 120
TA4310	2-part 1:1 longer handling time than TA4300, gap filling, toughened. Ideal for structural bonding of aluminium.	Part A: Off-white Part B: Brown Mixed: Cream	Thixo Paste	2	10-15 minutes	25-30	24-26	-40 to 120
TA4590 & Initiator 44	Methacrylic acid free structural adhesive for sensitive electronic components. Helps prevent corrosion of copper parts.	Resin: Blue Initiator: Green Mixed: Turquoise	Thixo	0.5	15-30 seconds	<2mins	20-25	-55 to +150
TA4592	Use with external mix equipment for high speed production lines. Rapid cure speed, no mixing nozzles needed.	Part A: Blue Part B: Yellow/ green Mixed: Turquoise	Thixo	1	<30 seconds	10-30 secs	20-25	-55 to +120

2-Part Epoxies

Permabond 2-part epoxy adhesives are suitable for bonding a wide variety of materials. Available with a range of different cure speeds, Permabond epoxies have been developed to offer a high standard of performance for demanding bonding applications.

Substrates
Permabond 2-part epoxy adhesives will bond most engineering materials. They form excellent structural bonds to a wide variety of materials including metals, composites, wood and some plastics.

Durability
Their excellent chemical and water resistance makes them suitable for harsh environmental conditions. These epoxies are an excellent choice for high-strength structural bonding.

Applications
Epoxies are widely used in the marine, automotive, aerospace, appliance, general assembly and construction industries. Applications are diverse and include bonding aerospace structures, motor housings and mounting brackets, tools and kitchen counter tops amongst many others.

Material selection
The high strength and durability achieved using these adhesives provides designers with greater design freedom in their selection of substrate materials.

Process
1:1 and 2:1 mix epoxies can be easily dispensed with a static mixing nozzle -no measuring or hand mixing is needed. Heat cure is not needed as the adhesives will cure at room temperature. Heat can be used to accelerate the speed of cure quoted on the chart opposite.

Joint Design
Joint design possibilities are greatly improved by the high shear and peel strength of joints bonded with these adhesives and by the increased stress distribution that they offer.

Benefits

- High peel strength increases design versatility.
- Easy mix ratio of most Permabond 2-component epoxies reduces equipment costs.
- Durability increases material choices.
- Rapid cure increases production rates.
- Room temperature cure reduces equipment & energy costs.
- Solvent free formulation improves workplace safety.
- Low odour improves workplace environment.

Permabond®
Engineering Adhesives

2-Part Epoxy Product Chart

Grade	Description	Appearance (mixed)	Typical Mixed Viscosity (mPa.s)	Max. Gap Fill (mm)	Pot life	Handling Time	Shear Strength (MPa)	Service Temperature (°C)
ET500	Very fast curing, clear, non-yellowing.	Clear, transparent	17,000	2.0	3-4 mins	4-6 mins	12-14	-40 to +80
ET502	High viscosity version of ET500.	Clear, transparent	44,000	4.0	2-3 mins	5-6 mins	8-12	-40 to +80
ET5011	Slower curing version of ET500.	Clear, transparent	56,000	2.0	10-25 mins	25-30 mins	6-12	-40 to +80
ET505	Tough, structural multipurpose adhesive for bonding a wide variety of materials.	Amber	19,000	2.0	1-2 hours	2-3 hours	18-21	-40 to +80
ET510	Rapid curing and flexible for excellent impact and peel resistance.	Amber	21,000	2.0	10-15 mins	15-25 mins	8-12	-40 to +80
ET514	Toughened structural epoxy. Faster curing version of ET538.	Grey	70,000	2.0	30-40 mins	40-60 mins	18-20	-40 to +80
ET515	Clear and flexible, again with excellent peel and impact resistance.	Slightly amber	20,000	2.0	10-15 mins	15-25 mins	8-12	-40 to +80
ET536	Toughened, thixotropic, excellent gap fill and flow control.	Grey	290,000	5.0	30-45 mins	60-90 mins	15-24	-40 to +80
ET538	Toughened, thixotropic, excellent gap fill and flow control. Long pot life for large assemblies.	Grey	195,000	5.0	2-3 hours	3-4 hours	18-20	-40 to +80
ET5145	Controlled flow FDA compliant epoxy for food and beverage applications	White	80,000	2.0	20-40 mins	N/A	19-21	-40 to +80
ET5147	High temperature resistant FDA compliant epoxy for food and beverage applications	White	70,000	2.0	20-40 mins	N/A	18-20	-40 to +120
ET5401	Toughened, thixotropic, excellent gap fill and flow control, improved temperature resistance.	Grey	Thick Paste	5.0	10-12 mins	3-4 hours	20-30*	-40 to +140°C (continuous) +180°C (peak)
ET5411	High temperature resistant, low viscosity.	Grey	8,500	2.0	16 hours	Heat cure required	21	-40 to +150°C (continuous) +300°C (peak)
ET5428	Composite bonding grade with rapid cure speed. Colour matched for bonding GRP or Carbon Fibre.	Available in cream or charcoal black	25,000	5.0	10 mins	1 hour	18-22	-40 to +80
ET5429	Composite bonding grade with longer pot life.	Charcoal black	175,000	5.0	2 hours	N/A	18-22	-40 to +80
MT382	Modified epoxy hybvrid, low modulus, self-levelling. Ideal for bonding composites or potting applications.	Charcoal black	25,000	0.5	10-20 mins	30-60 mins	4-7	-40 to +80
MT3281	High viscosity version of MT382	Charcoal black	133,000	5.0	10-20 mins	45-75 mins	4-7	-40 to +80

**Heat cure required to achieve maximum strength performance*

Single-Part Epoxies

Permabond single-part epoxy adhesives are suitable for bonding a wide variety of materials. They are available with a range of different viscosities and characteristics. Permabond epoxies have been developed to offer a high standard of performance for demanding applications.

Substrates

Permabond single-part epoxy adhesives will bond most engineering materials. They form excellent structural bonds to a wide variety of materials including metals, composites, ferrites and some plastics.

Durability

These adhesives offer excellent performance at high temperatures and harsh environmental conditions, having superb resistance to many aggressive chemicals.

Applications

Single-part epoxies are ideal for use in heavy wear-and-tear applications such as bonding tungsten carbide tools & machinery. They are ideal for replacing welding and brazing and can significantly reduce assembly production costs. For this reason their use is widespread in the heat exchanger bonding market for sealing heat exchanger tubes and end-plates.

Material selection

By replacing welding or brazing, the designer can have greater freedom of choice of manufacturing materials and can bond dissimilar substrates together. This can help reduce component cost and weight as well as improve performance.

Process

These adhesives are available in cartridge form or in bulk to dispense via automated dispensing equipment. They fully cure rapidly when exposed to heat via the use of an oven, induction coil, infra-red or hot air gun.

Joint Design

Joint design possibilities are greatly improved by the high shear and peel strength of joints bonded with these adhesives and by the increased stress distribution that they offer.

Benefits

- High peel strength increases design versatility
- No requirement for weighing or mixing material
- Durability increases material choices
- Rapid full cure increases production rates
- Solvent free improves workplace safety
- Low odour improves workplace environment
- Excellent high temperature resistance and can withstand harsh environmental conditions
- An effective alternative to welding or brazing

Permabond®
Engineering Adhesives

Single-Part Epoxy Product Chart

Grade	Features	Colour	Viscosity (mPa.s)	Max. Gap Fill (mm)	Cure Schedule	Shear Strength (MPa)	Service Temperature (°C)
ES550	Toughened, non-sagging at curing temperature, excellent environmental resistance, good thermal conductivity.	Grey	1,000,000 to 2,000,000	3.0	130°C: 45 minutes 150°C: 30 minutes	27-41	-40 to +180
ES558	Toughened, free flowing at curing temperature, excellent environmental resistance, good thermal conductivity.	Grey	100,000 - 300,000	0.5	130°C: 60 minutes 150°C: 45 minutes	27-41	-40 to +180
ES560	Free flowing for potting and encapsulation.	Transparent when cured. Black version available.	1000-3000	0.1	120°C: 40 minutes 150°C: 20 minutes	14-20	-40 to +180
ES561	Self levelling	Amber	12,000	0.2	150°C: 15 minutes	15	-40 to +180
ES562	Self-levelling, free flowing at curing temperature.	White	15,000 - 25,000	0.25	120°C: 45 minutes 150°C: 30 minutes	20-35	-40 to +180
ES566	Lower temperature curing grade, ideal for bonding difficult plastics	Grey	150,000-300,000 T	2	80°C: 60 minutes 100°C: 30 minutes 120°C: 15 minutes	9-15	-40 to +180
ES568	Rapid curing, general purpose with good adhesion to a variety of surfaces.	Ivory	30,000-80,000	0.5	120°C: 50 minutes 135°C: 25 minutes 150°C: 15 minutes	20-25	-40 to +180
ES569	High strength bonding, non-sagging at curing temperature.	Black	250,000 to 500,000	5.0	130°C: 60 minutes 150°C: 45 minutes	27-41	-40 to +180
ES578	Good thermal conductivity, excellent electrical insulation.	Black	600,000 - 800,000	5.0	130°C: 60 minutes 150°C: 30 minutes	27-41	-40 to +180
ES579	Good thermal conductivity, excellent electrical insulation. High temperature resistance. Cures at low temperature.	Ivory	60,000-90,000	2.0	100°C: 240 minutes 120°C: 60 minutes 150°C: 45 minutes 180°C: 20 minutes	27-41	-40 to +180
ES5504	Exceptionally high temperature resistance.	Grey	Paste	2.0	150°C for 1 hour plus 200°C for 1 hour	18-22 (aluminium)	-40 to +250 (continuous) +300 (peak)
ES5675	Non-flowing. Ideal for bonding filter seams. Low temperature cure.	Grey	400,000-1,200,000	3.0	90°C: 180 minutes 100°C: 90 minutes 120°C: 45 minutes	20-25	-40 to +180
ES5691	UV-Fluorescing for high speed production lines. High wet-strength, non-stringing formulation ideal for bonding electrical components.	White	500,000-600,000 Thixo	5.0	130 - 150°C: 60 - 80 minutes	27-41	-40 to +180
ES5741	Ideal for bonding PBT and other difficult plastics. Rapid low temperature cure.	Orange	20,000-30,000	0.5	100°C: 45 minutes 120°C: 30 minutes 150°C: 10 minutes	12-15 (aluminium)	-40 to +180
ES5722	Gap filling, ideal for bonding mesh screens.	Grey	150,000-300,000 Thixo	5.0	130°C: 60 minutes 150°C: 45 minutes	20-30	-40 to +180


ES adhesive for coil winding

UV-Curable Adhesives

Permabond UV-curable adhesives are single part, cure on demand adhesives suitable for bonding a wide variety of substrates. Upon exposure to UV light, Permabond UV curables will cure to a high strength in a matter of seconds.

Permabond UV curable adhesives are suitable for a variety of applications.

They are excellent for bonding glass to glass or glass to metal and form very high strength bonds for load bearing joints, such as those found in glass furniture and display cases.

Flexible and stress absorbing, Permabond UV curable adhesives are suited to applications where substrates with different thermal expansions need to be bonded.

Permabond UV curable adhesives bond a wide variety of plastics. Some clear plastics contain UV stabilizers that block the transmission of UV light, but they can still be bonded with visable light curing adhesives. Permabond's technical staff can help you identify the UV characteristics of the plastic you are using.

Typical applications include:

- Bonding glass furniture
- Glass to metal structural bonding
- Acrylic display racks
- Lenses
- Solar panels
- Trophies and glass ornaments

Permabond UV curable adhesives form strong and durable bonds.

Permabond UV curable adhesives cure during exposure to ultra violet light. The adhesives contain photo-initiators that react to specific wavelengths, causing the curing process to begin.

UV adhesives do not dissolve, melt or weaken the two components. They form strong chemical bonds between the two substrates and provide a high strength alternative to other joining methods.

Lamps are available in a variety of intensities from small inexpensive hobby type lamps to larger high intensity units for high speed production. Permabond will help you select the equipment best suited to your specific application.

Benefits

- Cure on demand - allows proper alignment of components before bonding.
- Cure speed - increase production by simply adding more lamps to the line.
- Non-flammable and solvent-free - provides a safe and comfortable work environment.
- Single part product - No mixing required.
- 100% solids equal no waste and no VOCs
- Save energy and space - UV lamps require less electricity and space compared to ovens.
- Appearance - UV adhesives provide quality aesthetics.
- Technical support- application specialists available for assistance with joint design, adhesive selection and production process.

Cure speed of UV-curable adhesives:

There are a number of factors which determine the cure speed of UV-curable adhesives (not just the reactivity of the adhesive itself):
-Intensity of UV-light and distance from the source
-Type of UV bulb - there are a variety of bulb types and LEDs with different power outputs and spectra
-Age of the UV bulb (UV output of bulbs reduces with age)
-Light transmittance of the materials being bonded (many plastics have UV-stabilisers which block UV rays).

UV-Curables Product Chart

Grade	Description	Appearance	Viscosity (mPa.s)	Fixture time (secs) Low powered 4mW/cm lamp	Tensile strength (MPa)	Lap shear strength (MPa)	Hardness (Shore D)	Service Temperature (°C)
UV605	Very low viscosity	Clear, colourless	50-100	15	14	Steel to glass 5-7	68	-55 to +120
UV610	High strength bonding for glass to metal.	Translucent	800-1000	11	17	Steel to glass 13-16	70	-55 to +120
UV612	Bevel bonding grade with slow cure and easy clean-up	Clear, colourless	400-500	15	5	N/A	35	-55 to +120
UV620	General purpose, optically clear, excellent resistance to yellowing.	Clear, colourless	2000-3000	5	16	Steel to glass 9-10	62	-55 to +120
UV625	Non-drip for larger gaps and vertical applications.	Clear, colourless	Gel	5	16.5	Steel to glass 10-11	65	-55 to +120
UV630	Low viscosity, plastic bonding.	Clear, colourless	200-300	6	14	PC to PC >9*	60	-55 to +120
UV632	Particularly good for bonding acrylic substrate material.	Clear, colourless	3000-4000	Refer to TDS	13	PC to PC >5*	60	-55 to +120
UV640	Medium viscosity, plastic bonding.	Clear, colourless	3000-4000	7	13	PC to PC >9*	60	-55 to +120
UV645	Plastic bonding. Good adhesion to acrylic.	Clear, colourless	10,000-12,000	7	11	PC to PC >9*	65	-55 to +120
UV648	High viscosity, excellent adhesion to acrylic substrates.	Clear, colourless	Gel	Refer to TDS	11	PC to PC >5*	60	-55 to +120
UV649	Plastic bonding gel.	Clear, colourless	Gel	7	15	PC to PC >9*	65	-55 to +120
UV670	Flexible for metal and metallized plastics.	Clear, colourless	2000-3000	7	12	Steel to glass 8-9	58	-55 to +120
UV675	For crystal clear bonding of glass.	Clear, colourless	500-600	7	16	Steel to glass 13	70	-55 to +120
UV681	Tack-free coating UV. Ideal for encapsulation.	Clear, colourless	80-100	3.5	11	N/A	65	-55 to +120
UV683	Tack-free UV for encapsulation or doming applications.	Clear, colourless	1000-1500	3.5	13	N/A	60	-55 to +120
UV6231	Excellent resistance to moisture and harsh environmental conditions	Clear, colourless	6000-7000	<10	9	Steel to glass 6-7 (after 500hrs 90% humidity @ 70°C)	47	-55 to +120
UV6160	Maintains optical clarity even in high stress joints	Clear, colourless	1000-2000	<10	20	Steel to glass 11	70	-55 to +120
UV7141	UV and anaerobic curing. For bonding ceramic coated glass, mirrors, glass and metal.	Clear/colourless liquid, slightly yellow when cured	1000-2000	15	20	Steel to glass 14-17	-	-55 to +150
UV7144	UV/AA dual cure product for curing in shadow areas on metal parts.	Green	500-600	15 (60mW)	30	N/A	-	-55 to +150
UV7145	UV/AA dual cure product for curing in shadow areas on metal parts.	Green	2000-3000	15 (60mW)	24	Steel to glass 17-24	-	-55 to +150
UV7148	UV/AA dual cure product for curing in shadow areas on metal parts.	Red	4000-5000 Thixo	7	N/A	N/A	80	-55 to +150
UV7182	UV/Moisture dual cure (PU acrylate) for cure in shadow areas.	Amber	1000-4000	7	6	N/A	65 (A)	-55 to +120

MS-Polymers

Permabond MS-Polymers are single-part moisture cure “sealant”-type products. They cure slowly from the outside in to form tough, yet flexible, bonded joints. Products are available either as gap filling paste or lower viscosity self-levelling compounds suitable for potting or for bonding close-fitting substrate materials.

Substrates
Permabond MS-Polymers can be used to bond most materials including wood, metal, glass, plasterboard and a wide range of plastics. As they rely on moisture for the cure, cure speed will depend on humidity and moisture in the air and on the substrate surface.

Durability
MS Polymers have excellent resistance to harsh environmental conditions including cyclic temperature conditions and water submersion - in fact the adhesives strengthen in wet conditions. They work well on substrates where differential expansion and contraction could be an issue.

Applications
Ideal for use in the building construction industry, bathrooms and glazing. Permabond MS359 CLEAR offers an excellent aesthetic finish on glass.

Benefits

- Soft & flexible - impact and vibration resistant
- No requirement for weighing or mixing material
- Can be dispensed with low-cost caulking gun
- Do not contain silicone or isocyanates
- Can be painted
- Low shrinkage and does not leave witness marks
- Instant grab and fast skin-over time
- Excellent environmental resistance

2-Part Polyurethanes

Permabond 2-part polyurethane adhesives are fast-setting structural adhesives ideal for bonding a wide range of substrate materials, in particular composites and metal. They have high strength performance due to a toughened matrix and excellent temperature resistance and durability.

Substrates
Permabond 2-part PUs can be used to bond most materials including metal, composite materials, wood and a variety of different plastics.

Durability
Permabond 2-Part polyurethanes have a higher service temperature range than standard 2-Part epoxy adhesives and offer excellent environmental resistance.

Applications
Ideal for use on carbon fibre automotive parts, structural bonding applications, as well high speed production items such as electronic chip / component bonding or potting.

Benefits

- High peel strength and good impact resistance
- Easy 1:1 mix ratio
- Available in cartridges
- Rapid setting time
- High temperature resistance

Permabond® Engineering Adhesives

MS Polymers

Grade	Features	Colour	Viscosity (mPa.s)	Skin Over Time	Approximate Cure Rate	Tensile Strength (MPa)	Service Temperature (°C)
MS359 GREY	Single-part moisture curing low-modulus. Bonds most materials, ideal for building construction applications.	Grey	Non-sagging paste	10-25 mins	2mm every 24 hours	1-2	-40 to +100
MS359 CLEAR	Clear, transparent single part moisture curing sealant. Ideal for bonding glass, composite, metal, wood and plastics.	Transparent, colourless	Non-sagging paste	10-20 mins	4mm every 24 hours	1-2	-40 to +100
MS359A GREY	Self-levelling lower viscosity version of MS359 GREY	Grey	15,000-70,000	10-20 mins	3-4mm every 24 hours	0.5-1.5	-40 to +100

2-Part Polyurethanes

Grade	Features	Colour	Viscosity (mPa.s)	Max. Gap Fill (mm)	Pot Life	Shear Strength (MPa)	Service Temperature (°C)
PT321	Very rapid curing 1:1 PU. Ideal for bonding composites, metals, plastics and woods.	Grey	5500	0.5	60 seconds	18-25	-40 to +120
PT326	Slower setting version	Grey	15,000	5.0	4-7 minutes	12-20	-40 to +120
PT328	Even slower setting version	Grey	5500 thixotropic	5.0	15-20 minutes	11-16	-40 to +120

Other Products

Grade	Features
Permabond Cleaner A	General purpose surface cleaner
Permabond 2K Primer	Silane surface pretreatment
Isopropanol Wipes	Convenient sachet packaging
CA Solvent 2	For dissolving cured cyanoacrylate adhesive

Permabond also supplies a number of sundry items such as nozzles and guns. For automatic dispensing equipment or UV curing equipment, please contact Permabond for assistance.

PT326 for automotive carbon fibre bonding

Basic Approvals / Standards List

Approval	Grades with Approval
WRAS Drinking water (cold water and hot water up to 85°C)	A011, A025, A113, A115, A118, A130, A131, A136, A140, A1042, A1044, A1058, F200, F201, F202, A1084, HM135, MH052
WRAS Drinking water (cold water use only)	102, 105, 240, 2010
AGA (Australian Gas Association)	A131, A1044
DVGW (Deutscher Verein des Gas- und Wasserfaches)	A1046, A1058, HH131, MH052
KIWA Gastec	A131
ISO10993 Cytotoxicity	4C10, 4C20, 4C30, 4C40, 4UV80, UV630
Aerospace Approval - check with Permabond for further details	102, 910, TA4246
MIL SPEC	Listed on www.permabond.com
Customer specific	Check with Permabond
RoHS (Restriction of Hazardous Substances)	Most products comply; letter available
REACH (Registration, Evaluation, Authorisation and restriction of Chemicals.)	Most products comply, letter available
UL94V-0 (Underwriter's Laboratory)	ES578 and ET527.0 compliant. Permabond letter available
FDA (Food and Drug Administration)	ET5145 and ET5147 formulated with FDA compliant raw materials
NSF (National Sanitation Foundation)	LH050PURE, MM115PURE, HH040PURE (US products)

Conversion Tables

Weight

1 kilogram (kg)	= 1000 grams (g) = 2.2 pounds (lbs)
1 pound (lb)	= 16 ounces (oz) = 453.6 grams (g)
1 ounce (oz)	= 28.35 grams (g)
1 gram (g)	= 1,000 milligrams (mg)

Length

1 metre (m)	= 100 centimetres (cm) = 1000 millimetres (mm) = 3.28 feet = 39.37 inches
1 inch	= 2.54 centimetres (cm) = 25.4 millimetres (mm) = 1000 mil (thou)
1 centimetre (cm)	= 0.39 inches = 10 millimetres (mm)
1 millimetre (mm)	= 1,000 microns (µm)
1 mil (thou)	= 40 microns

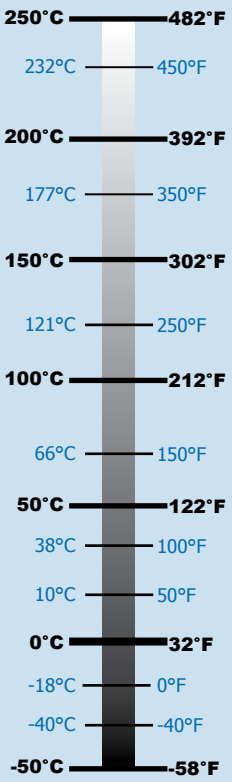
Volume

1 US gallon	= 8 US pints = 3.79 litres = 4 US quarts = 0.83 UK gallons
1 Imperial gallon	= 8 UK pints = 4.55 litres = 4 UK quarts = 1.2 US gallons
1 litre	= 1000 millilitres (ml) = 0.22 UK gallons = 0.26 US gallons = 1.76 UK pints = 2.11 US pints = 33.81 fluid ounces
1 US pint	= 473 millilitres (ml)
1 UK pint	= 568 millilitres (ml)
1 millilitre (ml)	= 1 cubic centimetre (cc)
1 cubic inch	= 16.39 cubic centimetres
1 microlitre	= 0.001 millilitres

Pressure

1 MPa	=145 psi
1 psi	=0.0069 MPa
1 MPa	=1 N/mm²
1 bar	=14.50 psi
1 psi	=0.069 bar

Temperature



Glossary

Activator (or accelerator) A substance which accelerates the cure rate of adhesive.
Adhesion Failure Failure of the adhesive to the substrate. No adhesive is left on the substrate. Improving surface preparation can help avoid this.
Ageing Adhesives can age from the effects of heat, chemical exposure and humidity. Accelerated ageing tests can be carried out in extreme environments for a quick indication as to the longevity of the adhesive.
Blooming A phenomenon associated with cyanoacrylate adhesives seen as a white powdery residue on substrate material.
Capillary Action Low viscosity adhesives will seep into narrow gaps which makes them suitable for post-assembly application.
Coefficient of Expansion A measure of the extent to which a material expands. Linear coefficient expansion units commonly used are mm/mm/°C x 10^{-6}. This is an important factor to bear in mind when bonding dissimilar materials in a temperature-changing environment.
Cohesive Failure Failure within the adhesive. On examination of failed parts, adhesive should be visible on both components.
Corona Treatment A method of surface preparation, mainly used for hard-to-bond plastics. High voltage discharge across substrate surfaces produces active electrons, helping raise the surface energy and 'wettability' to allow the material to be bonded.
Cyclic Ageing A harsh method of accelerated ageing, ideal for dissimilar materials. This usually involves heat ageing with cyclic temperatures so the effects of differential thermal expansion and contraction can be assessed.
Density The specific gravity of a material measured in g/cm³. Water is the benchmark at 1.0 (at 4°C).
Differential Thermal Expansion & Contraction This occurs when dissimilar materials are bonded together. They are likely to have different coefficients of expansion. Using a toughened or flexible adhesive can help reduce stress on components.
Elongation How much a material 'stretches', usually measured as a percentage.
Fillet The meniscus of adhesive that can be seen on the outside of a joint. When cured, this can help increase strength and protect joints against chemical and moisture ingress.
Flame Treatment A method of surface preparation, mainly used for hard-to-bond plastics. Briefly exposing surfaces to a flame increases surface electron activity, helping raise the surface energy and 'wettability' to allow the material to be bonded.
Glass Transition Temperature (Tg) The temperature at which a normally rigid, brittle "glass-like" structure changes to a soft, elastic material. This can help determine operating temperature limits.
Handling Time / Speed the time at which adhesive has cured to a sufficient strength to allow unclamping and gentle handling of the part.
Inhibition The presence of a chemical that can cause incomplete cure of adhesive. This could be oxygen preventing full cure of an anaerobic adhesive or chemicals within a substrate which could interfere with adhesive cure.
Modulus of Elasticity Determines the point at which a material becomes deformed under tension.
Open Time The length of time freshly applied adhesive is optimal for bonding (after which strength could be compromised).
Outgassing The release of gaseous molecules from adhesive.
Oxidation This commonly occurs in metals such as aluminium and iron (seen as rust) where surface electrons are stolen. Removal of weak oxide layers prior to bonding is recommended.
Passive Surface An unreactive metal surface that is highly resistant to chemical attack. Zinc and chrome are good examples. Use of surface activator, A905 helps cure anaerobic adhesives.
Plasma Treatment A method of surface preparation, mainly used for hard-to-bond plastics. It is a mixture of electrons and positive ions in a gas which is passed over the substrate, helping raise the surface energy and 'wettability' to allow the material to be bonded.
Pot life The maximum amount of time adhesive can be used after it has been mixed (in a pot!) before it starts becoming semi-cured and too difficult to apply.
Primer A substance that improves the adhesion of adhesives to components and can help improve environmental resistance.
Refractive Index How much a beam of light alters its angle as it passes through a material. Glass is approximately 1.4 to 1.6.
Relative Humidity How saturated air is with moisture (maximum 100%). Low humidity (usually in cold environments) can affect cyanoacrylate cure.
Rheometry How a material flows, slumps etc.
Room Temperature 23±1°C (as specified by DIN/ISO). Viscosity and strength measurements are taken at this temperature.
Shadow Cure This relates to UV-curable adhesives, UVs that have a single UV- cure mechanism will not cure in areas not reached by UV light.
Shore Hardness A scale set up to asses the hardness of a material. Materials measured on the Shore A scale are soft elastomers, Shore D are tough, harder materials. The test is done with a spring-weighted pin that measures depth of penetration (units are 0-100 Sh, the higher the number, the harder the material).
Substrate Failure Failure of the substrate. This is observed as the adhesive joint remains in tact and the substrate either breaks or the surface of the substrate delaminates.
Surface Tension / Surface Energy An example of a surface with low surface energy is a freshly polished car bonnet sprayed with water droplets. The water droplets stand proud. This is how hard-to bond materials such as polypropylene behave. Increasing surface energy makes the surface more 'wettable' and able to be bonded. Adhesives are developed to have as low a surface tension as possible to 'wet-out' on difficult surfaces.
Tensile Strength The strength of an adhesive joint pulled apart in tension.
Thixotropy The flow behaviour of an adhesive that causes the viscosity to reduce when stirred, mixed or dispensed but will then thicken upon standing (preventing slump and run-off).
Toughened Adhesives Can be rubber toughened to allow better flexibility, higher peel strength and better impact resistance. They are ideal for bonding dissimilar substrates where differential thermal expansion and contraction could be an issue.
Torque Strength Measurement of adhesive strength on threaded nuts and bolts. Breakout, prevailing and maximum strength can be measured to assess the 'lockability' of the adhesive. Units are usually Newton-metres (Nm) or in/lb.
Viscosity Measurement of how much a flowable substance flows. This can be measured with a spindle spinning to measure resistance, on an electronic rheometer or with a 'U' tube measuring time taken for material to flow from A to B.
Wettability / Wetting out If a substrate is 'wettable' it will allow liquid (such as adhesive) to be spread across it without droplets bunching up. If droplets do bunch up then the material could be difficult to bond and surface pretreatment may be required.
Working Time / Strength The time at which a newly bonded joint can be put into operation. The joint will have developed approximately 60% of its final strength so can be subjected to normal loading.

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